Iowa Initiative for Artificial Intelligence
Final Report

Project title:	**Assessing Social-Emotional Learning with Immersive Virtual Environments (SELIVE)**	
Principal Investigator:	Jared Izumi	
Prepared by (IIAI):	Tyler Bell	
Other investigators:		
Date:	2022-2023	
Were specific aims fulfilled:	Y	
Readiness for extramural proposal?	Y	
If yes … Planned submission date	TBD	
Funding agency		
Grant mechanism		
If no … Why not? What went wrong?		

<u>Brief summary of accomplished results:</u>

Social-emotional learning (SEL) is the combination of skills, knowledge, and attitudes that facilitate healthy personal identity, emotion management, goal attainment, empathy development, relationship building, and responsible decision-making. Ninety-five percent of school administrators want to develop SEL skills in their students; however, only 38% indicate that SEL measurement tools are useful for identifying students in need of additional support or services. Thus, our project developed a proof-of-concept virtual reality (VR) simulation for the direct assessment of SEL skills to evaluate a student's ability to problem-solve social and emotional tasks within a natural context. Where feasible, AI was embedded to help automate aspects of the simulation. The developed simulation platform was ultimately utilized within a preliminary user study. In this study, three grade-school-aged participants were placed within a virtual classroom situation that was designed to evoke a social-emotional response. Participant responses (verbal and physical) to these situations were recorded, along with their corresponding heart rate variability (HRV). While the majority of the results from the study are still being analyzed, it is our initial belief that the immersive environment served as an adequate testing-ground to evoke natural reactions such that social-emotional skills can be evaluated.

<u>Research report:</u>

Aims: Original aims of the project include the following:

<u>Aim 1</u>: Artificial intelligence will be able to categorize verbal responses by the user.

<u>Aim 2</u>: Demonstrate experimental control in the IVE.

Data:

The user study produced data that would be useful for subsequent research, especially if AI were to be increasingly responsible for managing the wide array of interactions seen with only three participants. The collected data includes participant voice reactions within the simulation, physical actions within the simulation, and heart rate variability.

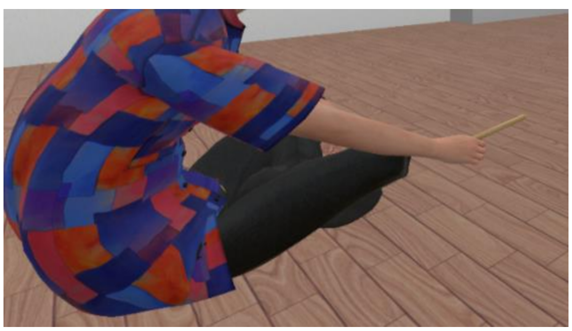
AI/ML Approach:

Experimental methods, validation approach:

An overall aim of this research was to develop a 'smart' VR simulation for social-emotional skills assessment, enabled by artificial intelligence. This was achieved by first creating a simulation for the Meta Quest 2 VR headset within the Unity game engine. This simulation modeled a specific classroom scenario designed to evoke a social-emotional response. Users in the VR headset would be placed within a virtual classroom, along with a virtual teacher and a virtual classmate. The teacher would begin by reading a short story. After an experimentally controlled amount of time, the classmate would begin to tap his pencil on the ground, with increasing loudness. Participants were then able to interact with the simulation to respond to this stimulus, either verbally or physically. Via IBM Watson AI integration, speech-to-text was able to transcribe user's verbal interactions. Several action recognizers were also integrated to automatically detect if the user raised their hand (to get the teacher's attention) or tried to physically interact with their classmate or his pencil. The simulation would respond to the user's interactions (e.g., the teacher would ask the student to stop tapping his pencil, or the student would show an angry face at the user, etc.) and then the teacher would continue reading the story. Networking capabilities were also integrated into the simulation in order to capture and log user heart rate variability (HRV) information broadcast from emWave, the software paired with an ear-worn HeartMath sensor.

(a)

(b)



(c)

(d)

Figure 1. Views of the simulated classroom, virtual student, and virtual teacher created in Unity. Users would be immersed in this room, listen to a short story, and then verbally and/or physically interact with the student from within the VR headset to stop the pencil tapping. (a) the virtual teacher who reads the short stories; (b) the virtual student who taps his pencil, responding to the user's reaction to the pencil tapping; (c) a close-up of the student tapping his pencil; (d) the "upset" or "angry" face given by the virtual student upon a user's physical reaction to stop the pencil tapping, for example.

The initial pilot study conducted within the immersive simulation involved recruiting several grade-school-aged students. These participants were placed within the simulation described above with their reactions to the stimulus observed by recording the user's in-headset (first-person) and external (third-person) perspectives. Although various features were incorporated within the simulation to help automate its progression, these features were disabled during the user study. In other words, the progression of the simulation was manually controlled by study personnel to ensure each of the study's limited participants were able to successfully complete the situation. That said, the captured recordings of participant speech and behavior would be useful in expanding the classification capabilities in future studies.

Within each session: (0) the participant would enter the headset and a VR tutorial would be given; (1) a short story would begin, being read aloud by the virtual teacher; (2) the story would end; (3) the participant would exit VR and then be interviewed to determine their comprehension of the story, its content, and details; (4) the user would enter VR and another short story would begin, being read aloud by the virtual teacher; (5) the pencil tapping would begin after a predetermined delay, tapping with increasing loudness; (6) the participant would respond verbally and/or physically to the teacher and/or classmate; (7) based on the reaction in (6), the teacher and/or classmate would respond accordingly; (8) the story would resume and continue until its end; and (9) the participant would exit VR and then be interviewed to determine their comprehension of the story, its content, and details. Each session concluded with the participant completing a survey to capture perception information about the simulation, aspects of VR, and their overall experience.

Results:

While the above VR simulation environment, several AI integrations, and a pilot user study has been completed, the resulting data from the study has yet to be analyzed. One factor for this is that PI Izumi left the University of Iowa during Summer 2023 (at the conclusion of the user study). It is anticipated that the captured data will be analyzed to ultimately help determine the simulation's overall effectiveness.

In addition to the aforementioned developments and efforts, this project helped the team develop crucial skills and explore new avenues for future research activities in the area of AI/VR integration. This includes experimentation with Whisper, an automatic speech recognition system developed by OpenAI; the installation and integration of a motion capture system to record skeletal animations for use within VR simulations (this was eventually used to create animations for both the virtual student and teacher); experience creating more dynamic and realistic human avatars (this was eventually used to create the virtual student and virtual teacher characters); and the capturing of biometric data within a VR simulation, enabling correlation between this biodata and VR events/interactions (this was eventually used to incorporate the HRV monitoring within the simulation).

Overall, it is our initial belief that the immersive environment served as an adequate testing-ground to evoke natural reactions such that social-emotional skills can be evaluated.